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Research Article

Physical sciences teachers' perspectives on implementing learning style-based instructional strategies in science classrooms: Challenges and opportunities

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This study investigates the perspectives of physical sciences teachers regarding implementing learning style-based instructional strategies [LSBIS] in science classrooms in South Africa. The aim is to identify the challenges and opportunities associated with integrating these strategies into teaching practices. Research on learning styles and instructional strategies that cater to different cognitive, affective, and physiological factors affecting how individuals learn and how teachers incorporate these into classroom teaching has received considerable focus in educational studies. The implementation of LSBIS in science education is still a subject of discussion, especially regarding its feasibility and efficiency. The study is framed within the Felder-Silverman Learning Style Model and the Social Constructivism Theory. A qualitative multiple case study design was utilised. Four physical sciences teachers from four schools in one education district were purposefully sampled to participate in the study. The interview was the main data collection tool. Data was analysed using the framework as advised by Creswell. The findings reveal a spectrum of perspectives regarding integrating learning style-based instructional strategies. While some teachers express enthusiasm and confidence in utilising these approaches to cater to diverse learner needs and enhance engagement, others voice scepticism and reservations about their utility and feasibility within the constraints of curriculum demands, classroom dynamics and limited resources. The findings illustrate the need for teachers to stress the need to be flexible and adaptable in teaching methods, promoting a blended approach that combines aspects of individualised education while aligning with curricular goals. Collaborative professional development programmes and access to pedagogical materials are crucial for improving teachers' ability to execute successful LSBIS. The study emphasises the need to have a detailed understanding and thoughtful consideration when applying LSBIS in science education. Therefore, it is recommended that teachers take a holistic approach that incorporates ideas from many educational philosophies and research findings on LSBIS, instead of using a uniform one-size-fits-all method in their science classrooms.

Keywords: Learners; Learning style-based instructions; Perspectives; Physical sciences; Teachers

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1. Introduction

Physical Sciences is one of the most valued subjects in schools all over the world, and in South Africa, there is great value attached to this subject as well. The Department of Basic Education [DBE] (2011) describes this value of physical sciences as "focusing on investigating physical and

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chemical phenomena through scientific inquiry. By applying scientific models, theories and laws it seeks to explain and predict events in our physical environment. The subject deals with society's desire to understand how the physical environment works, how to benefit from it and how to care for it responsibly" (DBE, 2011, p.13). However, despite its value, the performance of Physical Science learners has been of great concern since learners underperform in the subject (Danso, 2020; John, 2019; Nemadziva et al., 2023)).

Several studies conducted in South Africa, such as Makgato (2007), and Mji and Makgato (2006) investigated the primary factors that impact student performance in physical sciences. These scholars found that most physical sciences teachers have below the basic levels of science content knowledge and are incapable of answering questions aimed at their learners. They also found that discrepancies between teachers' instructional methods and students' learning preferences were among the factors that led to students' underperformance in the subject. Mji and Makgato (2006) suggest that the persistent low performance in the subject requires a united effort to implement steps to enhance the current situation. Hence, Froyd and Simpson (2010) recommend transitioning from a typical teacher-centred learning approach to a learner-centred method, where learners assume responsibility for their learning.

Learning styles pertain to individual preferences for how information is acquired and processed, including visual, auditory, intuitive, active and sequential modalities (Felder & Silverman, 1988). Learning styles are widely discussed, but their use in educational contexts is still being researched and debated (Kim et al., 2018). Several studies have shown that tailoring instructions to align with students' learning styles can enhance individual learning (Boateng & Mushayikwa, 2022; Danso, 2020; Stander et al., 2019). Integrating diverse learning styles in science education helps improve students' comprehension and engagement with the content of the subject. Research has shown that using various teaching methods that accommodate different learning styles can enhance academic performance and improve knowledge retention (Shaidullina et al, 2023). In addition, educational research has extensively debated and explored the influence of learning styles on instructional design. Proponents of learning styles advocate for adapting teaching methods to suit individual learning styles, while some argue in favour of standardised instructional strategies (Husmann & O'Loughlin, 2018; Pashler et al., 2008; Siddiquei & Khalid, 2021; Stander et al., 2019). Recognising the need to understand the variety of learners' preferences and cognitive styles in education has been acknowledged as a critical element of successful instructional design (Dunn & Dunn, 1978).

Teachers benefit from understanding their students' learning styles to identify their preferences and establish a conducive learning atmosphere in the classroom. It is, therefore, crucial to explore teachers' perspectives on using learning style-based instructions [LSBIS] to address learning style preferences among students to enhance their learning experiences. This study is in agreement with Coffield et al.'s (2008) emphasis on the necessity of empirical data to back the practical use of learning styles in education. The study aims to reveal useful insights into the perceived benefits, limitations, and overall influence of LSBIS on science learning outcomes by examining teachers' viewpoints. Examining teachers' views is crucial since they are essential in executing teaching methods and creating favourable learning environments (Kolb, 1984). Understanding teachers' perspectives can provide significant insights into the elements that affect instructional decision-making and the degree to which learning styles are incorporated into teaching methods.

Against this background, the study sought to find answers to the following questions:

RQ 1) How do physical science teachers perceive the preferred learning style-based instructional strategies, and how do these preferences align with the perceived learning needs of their students?

RQ 2) What are the challenges and barriers faced by physical science teachers in implementing learning style-based instructional strategies, and how do these factors influence their perceptions of the effectiveness of such approaches?

2. Literature Review

There are several definitions of learning style in the literature. Vita (2001) recommended that the most significant benchmarking definition of learning styles is the one given by Keefe (1979, p. 4), which states that "learning styles are stable indicators of how learners perceive, interact with, and respond to the learning environment". Gregorc (1979) defines learning style as unique characteristics that show how an individual takes in and deals with knowledge in an educational setting. Farajolahi and Nimvari (2014) argue that understanding one's learning type is crucial for developing effective learning strategies and optimising learning outcomes. Similarly, Willingham et al. (2015) asserted that several scholars, including Carl Jung, Felder and Silverman, Gregorc, and Kolb, have created multiple models of learning styles, which are commonly utilised in research projects. This implies that learning styles theories make references to different methods of learning and that instructions can be more effective when teaching is tailored to learners' unique learning styles.

Based on research conducted by the National Council on Teacher Quality (Greenberg et al., 2016), learning-style theory is covered in 67% of training programmes and is mentioned in 59% of the course literature. Despite its widespread appeal, scientists, and professionals from fields like education and educational psychology consider the notion of learning styles to be very contentious. Critics have pointed out the lack of empirical evidence and inaccuracies in the theory of learning styles, dismissing it as a myth and impractical (An & Carr, 2017; Rinekso, 2021; Uden et al., 2022). The contrast between widespread support from the general public, educational professionals, and other advocates and a doubtful scientific community requires a re-assessment of learning styles theory.

Aliakbari and Qasemi (2012) state that there are a minimum of 100 learning style models and instruments that share many similar concepts. Learning style models are crucial for elucidating students' preferred learning methods and their impact on academic success. The Curry "Onion" model, developed by Curry in 1983 and 1987, is an example of such a model. Curry's onion model categorises learning styles by allocating them to certain layers in a radial system, like the structure of an onion (Curry, 1983, 1987). The layers align closely with many learning style models, making it a suitable choice for graphically portraying concepts. The author examined the Curry "Onion" model and focused on the Felder-Silverman learning style model for designing questionnaires and instructional materials in a preliminary study of this project (Boateng & Mushayikwa, 2022). Felder and Spurlin (2005) state that the primary function of learning style is to create efficient instructional materials. Understanding the various student profiles in a class can help a teacher develop a strategy that caters to the needs of all learners.

Teaching styles refer to various ways and strategies teachers use to provide instruction and interact with students during the teaching-learning process. Teaching styles have a vital role in influencing students' academic performance and engagement, according to Chetty et al. (2019). Studies indicate that teachers in different fields have a preference for some teaching approaches over others (Constantinides & Antoniades, 2022; Sevilmiş & Yildiz, 2021). However, Ayatollahi and Ferdosi (2021) are of the view that teaching styles are linked to emotional intelligence since teachers' traits and attitudes have a notable impact on the teaching process. Armin (2023) was of the view that every aspect of a teacher's approach to the classroom, from how they interact with students to how they organise their lessons and the resources they employ, contributes to the overall success of their lessons and the knowledge their students take away from them. Teaching styles have a substantial influence on students' learning experiences, making them an essential part of the educational environment (Rahayu, 2018). The correlation between teaching methods and students' learning preferences is crucial, as the alignment of these styles can improve the effectiveness of teaching and reduce disputes in the classroom (Zhang & Liu, 2012). However, teaching styles are complex and involve several aspects such as instructional methods, teacher-student relationships, and their influence on students' learning experiences. Knowing and

efficiently employing various teaching styles are crucial for establishing captivating and efficient learning settings.

The literature on matching learning styles and teaching styles presents a diverse range of perspectives and findings, contributing to the ongoing debate on the effectiveness of aligning instructional methods with students' learning preferences. Several studies have emphasized the potential benefits of matching teaching styles with learning styles. For instance, Reid (1995, 2005) suggested that matching teaching styles with learning styles provides all students with an equal chance in the classroom and builds student self-awareness. Also, Alnujaidi (2018) confirmed that students' motivation, performance, and accomplishment improve when their learning styles align with teaching approaches. In addition, Rinekso (2021) found that aligning learning styles with teaching methods/styles resulted in favourable outcomes for the learning process, such as increased motivation, engagement, and accomplishment.

Nevertheless, the literature contains conflicting perspectives about the efficacy of aligning teaching and learning styles. In one study, Alnujaidi (2018) found that when English as a Foreign Language (EFL) students' preferred learning styles were matched with their teachers' instructional approaches, there was a notable enhancement in students' learning, achievement, and attitudes towards the subject matter (Alnujaidi, 2018). Durmus and Güven (2020) found no significant correlation between different teaching and learning styles, indicating that the correlation between English teachers' teaching methods and English students' learning styles may not be direct. The literature on the alignment of learning styles and teaching styles is intricate and varied, with research showing both positive and neutral results on the effects of matching instructional approaches with students' learning preferences. The variety of viewpoints and study results add to the ongoing discussion over how well matching teaching and learning styles work together, emphasising the necessity for more research to fully grasp the impact of this alignment on student achievement.

However, implementing instructions tailored to learners' learning styles poses several challenges for teachers. Identifying learners' distinct learning styles is the initial hurdle (Sahid et al., 2017). After identification, the next step is to customise teaching methods and activities to match learners' predispositions, which can greatly influence their learning outcomes (Magulod, 2019). Nonetheless, there is little evidence to support the idea that learners get an advantage from receiving instructions customised to their learning style (Yankulov & Lu, 2017). The absence of data concerns the efficacy of LSBIS. Some say that research on learning styles has not been rigorous and lacks evidence to justify the use of instruction based on learning styles (Danso, 2020). Another problem is ensuring a suitable alignment between learners' learning styles and instructional methods, particularly within the realm of collaborative technology (Sek et al., 2016). This emphasises the challenge of accommodating diverse learning styles in collaborative educational settings.

Teachers' awareness of adapting their teaching methods to match students' learning styles is a critical element in education that greatly influences students' academic achievement. Soleimani (2020) explores the epistemological views and prevalent teaching methods of English language teaching [ELT] teachers, highlighting the learner-centred approach that emphasises the active participation of learners in the educational setting. Teachers must be cognizant of students' learning patterns to influence their teaching methods effectively. Jepsen et al. (2015) sought to determine how students' learning styles are connected to their views on teaching quality, emphasising the significance of matching teaching approaches with various learning styles. The study by Agustrianita et al. (2019) highlighted that teachers' awareness of students' learning styles can help them create teaching methods that suit different learning styles, improving the effectiveness of the teaching and learning process.

3. Theoretical Framework

The Felder-Silverman model is utilised in educational research to categorise students into groups according to their learning style preferences. This model has been linked to students' academic achievement across different subjects (Zagulova et al., 2019). The Felder-Silverman learning styles model acknowledges the existence of several dimensions of learning. The dimensions create a continuous line for individuals to arrange themselves from one end to the other. This allows for almost continuous variations in the combinations. Similarly, there are several aspects of teaching styles. Teaching styles are tools provided by teachers to help learners gain an in-depth understanding of the topic being studied. The Felder-Silverman (1988) model was chosen as the pedagogical basis for teaching and learning since it has been successfully used in previous research.

Felder and Silverman (1988) utilised several teaching methods to align with the preferences of the learners' learning styles. According to Felder and Silverman (1988), learners who prefer a specific learning style may encounter challenges if teaching styles differ from their preferences. Dunn (1990) emphasises the significance of educating students by employing techniques that cater to their conceptual preferences among various teaching strategies. Cabrero (2006) argues that utilising various teaching styles will affect the quality of education from a collaborative perspective. An essential component of this study is combining learning types with instructional strategies.

Constructivism philosophy highlights the active creation of knowledge by learners through their experiences and interactions with the environment (Vygotsky, 1978). This theory suggests that learners are central to the learning process and actively participate in developing their understanding of topics (Bai et al., 2018). The constructivism approach emphasises the need to create a motivating learning environment for learners to actively participate in the learning process (Baldock & Murphrey, 2020). This learning strategy is important for creating instructions that match learners' learning styles by focusing on customising educational experiences to meet individual student's needs and backgrounds (Kiss & Redlo, 2020). Constructivism theory supports instructional materials that are relevant and engaging to catch learners' interest and encourage their involvement with the subject matter (Bella et al., 2021). This supports the concept that learners build knowledge through their own experiences and interactions with educational resources (Sajadi & Khan, 2014). The approach focuses on constructing information from learners' previous experiences to guide the creation of instructions that accommodate various learning styles and preferences. The study utilised the social constructivist framework to shape the methodology. This framework helped in designing instructions with the implementation of LSBIS to determine teachers' perspectives on the tool.

4. Methods

4.1. Research Approach

This study is a longitudinal study which employed mixed methods for an intervention study (see Danso, 2020). This paper reports only on a small section of qualitative research design to understand teachers' perspectives on the implementation of learning style-based instructions in science classrooms. This approach allows for an in-depth exploration of teachers' beliefs, attitudes, and experiences, providing valuable insights into their instructional behaviours and the impact on student learning (Ng et al., 2015). A multiple case study design was highly suitable for understanding teachers' perspectives on the implementation of LSBIS in science classrooms. The use of multiple cases enables the author to compare and contrast different teachers' perspectives, thus offering a rich and multifaceted understanding of the phenomenon.

4.2. Sampling and Sampling Procedures

This study utilised purposeful sampling. This sampling method allows researchers to choose people capable of offering detailed insights and abundant information on the subject (Etikan &

Bala, 2017). Researchers can have a thorough comprehension of the subject matter by intentionally selecting volunteers who have firsthand experience with the phenomena being studied. The research intentionally selected one teacher from each of the four schools, providing an equal representation of both genders, resulting in a total of four physical sciences teachers (two males and two females). In addition, the four teachers were chosen because they implemented LSBIS in their respective classrooms during the main study.

Four physical sciences teachers were selected for the investigation. There are an equal number of female teachers and male teachers, with two of each. The teachers were assigned pseudonyms. The participants had 10 to 25 years of high school teaching experience and consistently attended content gap and in-service training to enhance their subject knowledge. All participants possess a bachelor's degree along with either a teaching credential or an honours degree. Therefore, all of them were certified teachers. All participants taught physical science at the Further Education and Training [FET] level for grades 10, 11, and 12, and either mathematics or natural science at the General Education and Training [GET] level for years 8 and 9. Table 1 shows the demographic information of the participants.

Table 1
Teachers demographic profile

School Code	*Teachers' Pseudonym*	*Gender*	*Teaching Experience*	*Qualification*	*School Type*
A	PSTA	Female	22 years	Diploma in Education, B.Ed (Sciences), Hons B.Ed (Sciences).	Former Model C
B	PSTB	Male	12 years	Hons B.Ed (Physical Sciences & Life Sciences	Public
C	PSTC	Male	10 years	Hons B.Ed (Physical Sciences & Maths	Public
D	PSTD	Female	20 years	BSc (Physics), PGCE (Physical Sciences and Natural Sciences).	Public

4.3. Research Instrument

The interview was the main instrument for data collection. The interview questions were developed following a literature study. The instrument was verified by three specialists in the field of teacher development: a university professor, the supervisor (since this study originated from the author's thesis), and a PhD candidate. Issues of readability were addressed during this process. Some of the questions highlighted in the interviews included: (a) what are your views about the learning style-based instructional strategies workshop? b) what do you understand by "learning styles"; c) what are your views about the implementation of learning style-based instructions in the sciences classroom? d) do you think that the implementation of learning style-based instructional strategies led to increased performance among learners; e) what are the challenges that you faced concerning the implementation of learning style-based instructional strategies in the sciences classroom?

4.4. Data Collection Procedure

The author arranged a three-day workshop for Grade 11 science teachers who were selected for the study. The workshop was conducted with the approval of the principals of the sampled schools and with the cooperation of the district subject adviser. A range of pedagogical approaches were listed, and deliberations were conducted on their development and implementation in the science classroom. Hence, the workshop familiarised science teachers with various methods that guided them towards the creation and use of instructional approaches that align with learners' individual

learning preferences, thereby enhancing learner performance in the subject. At the beginning of the workshop, each participant received a resource pack containing the programme outline, Felder-Silverman Learning Style Questionnaire [FSLSQ], a collection of articles on learning styles, a pamphlet on Felder-Silverman teaching and learning styles, the CAPS policy document, and a template for creating lesson plans on electricity and magnetism. The workshop utilised these resources, which can also function as reference materials for the participants.

On the first day of the workshop, the participants were acquainted with the concepts of learning and teaching styles. Therefore, the day was marked by regular periods of facilitation, small group discussions, and presentations. During the second day of the workshop, the author conducted a presentation on the development of instructional materials tailored to individual learning styles. A PowerPoint presentation was used to facilitate a discussion on the sequential process of developing teaching styles that align with different learning types. On the third day of the programme, the main emphasis was on preparing lessons and delivering group presentations. The group presentations varied in format, based on the specific learning goals and content of the subject. After each presentation, the author and the audience provided comments.

In this study, the topic of "electricity and magnetism" was chosen as the focus of the study. It was then separated into three sub-topics as outlined below: Electrostatics (namely Coulomb's Law and the concept of the electric field); Electromagnetism (a magnetic field that is generated by wires carrying an electric current, as well as Faraday's Law); Electric circuits (focusing on concepts such as energy and power). During the workshop, document analysis was performed to determine appropriate teaching styles suitable for classroom instruction for electricity and magnetism. It was found that some topics were descriptive, others were practical, and others had experimental or demonstrative material to comprehend the concepts and their underlying principles. For example, in "Coulomb's Law and electric field" within "electrostatics," it was determined that it was both demonstrative, providing evidence or proof, descriptive, providing detailed explanations, and deductive, based on logical reasoning. This suggests that it was necessary to employ various teaching methods to align with diverse learning styles in the classroom. Hence, the most suitable teaching methods for visual/verbal learners were demonstration and discussion, while brainstorming and case studies were most appropriate for active/reflective learners. Problem-solving and discussion were more suitable for sensitive/intuitive learners, and presentation and role plays were most appropriate for sequential/global learners when teaching these topics.

At the end of the workshop, the participants implemented these instructional approaches in their classrooms. Interviews were conducted with the participants after two terms of implementation (see Danso, 2020) to ascertain the thoughts and experiences of the participants regarding the adaptation of teaching styles to cater to the diverse needs of learners in the science classroom.

4.5. Data Analysis

The data collected during the interviews were transcribed first. The interviews' transcripts were reviewed to ensure correctness and gain familiarity with them. In the following phase, I conducted data reduction by utilising coding to pinpoint data that is pertinent to the study inquiries. Afterwards, I emphasised the information gathered during the interviews and categorised them based on the emerging pattern. During the coding process, I identified important areas of the respondents' assertions and used various patterns to create appropriate themes for the research questions using the procedures followed by Creswell (2012, p.1) as follows:

- Reading through the transcripts of the interviews (to assess for accuracy),
- Reading through the transcripts several times while highlighting comments or phrases that were representative of the participants' attitudes and thoughts,
- Clustering/categorising highlighted statements,
- Organizing the summary and emerging themes in the data.

The selected schools were labelled as School A, B, C and D. Participants in the study were given pseudonyms according to their schools. The four teachers from each of the schools were named as PSTA, PSTB, PSTC, and PSTD.

4.6. Establishing Trustworthiness

I used confirmability and member checking to ensure the legitimacy of the data. Data credibility can be attained by confirmation (Merriam, 2015). I verified the data I gathered with the research participants. I offered all participants chances to rectify mistakes and clarify necessary corrections. In addition, I employed member-checking to enhance credibility by sharing interview transcripts with participants and requesting their input, as outlined by Creswell (2008). This allowed participants to evaluate the findings critically and remark on them to see if they accurately represented what occurred during the interviews. This was essential to ensure the authenticity, originality, and reliability of the findings. Detailed notes on data collection, processing, and any revisions were utilised in this investigation to ensure the reliability of the findings and to allow other scholars to replicate this study in a similar context.

4.7. Ethical Considerations

At the commencement of the project, ethical approval was acquired to perform human research through interviews, adhering to the Wits Guidelines for Human Research Ethics Clearance Application (Non-medical). The committee approved the study under Protocol number 2016ECE004D on March 29, 2016. Permission was granted by the Eastern Cape Department of Education [ECDoE] to conduct the study in schools. A rapport was established with the school administrators, the principals of the different schools, and the teachers to facilitate the study. The study participants were guaranteed that their responses would be kept anonymous and confidential solely for research purposes.

5. Findings

Table 2 shows the generated themes and sub-themes which were used to present and discuss the results of the study.

Table 2
Generated themes and sub-themes

Research Questions	*Generated Themes*	*Generated Sub-Themes*
1. How do physical science teachers perceive the preferred learning style-based instructional strategies, and how do these preferences align with the perceived learning needs of their students?	Theme 1: Teachers' Perception of learning style-based instructional strategies.	Teachers' perceptions of the short professional development intervention.
		Teacher understanding of learning style-based instructions.
		Teachers' views about the benefits of implementing learning style-based instructions.
	Theme 2: Teacher perception of learning needs of learners.	Learning needs of learners.
2. What are the challenges and barriers faced by physical science teachers in implementing learning style-based instructional strategies, and how do these challenges influence their perceptions of the effectiveness of such approaches?	Theme 3: Teachers' perceptions of the challenges of implementing learning style-based instructional strategies.	Teachers' perceptions of the challenges of implementing learning style-based instructional strategies.
	Theme 4: Influence of perception of effectiveness of learning style-based instructions.	Influence of challenges on teachers' perceptions.
		Support received from the school when implementing the learning style-based instructional strategies.

5.2. Teachers' Perception of Learning Style-based Instructional Strategies

The brief professional development intervention used in this study was referenced (see Danso, 2020). The participants were interviewed to gain an understanding of their views on the sessions and to assess how this new knowledge would influence their future teaching approaches. Results indicate that 50% of the teachers interviewed were not aware of the concept of learning styles and instructions based on learning styles before the intervention workshop. However, the two participants who knew about it failed to develop instructions tailored to the learners' learning styles. Following the brief professional intervention, teachers' understanding of creating instructional materials tailored to learners' learning styles and delivering instruction based on learners' style preferences changed. Participants shared the following sentiments:

> I desire an extension of the intervention programme to further explore LSBIS which I see to be very innovative (PSTA).
>
> I propose extending the training programme by a week to further explore the development of LSBIS resources to help my learners achieve higher grades in physical sciences (PSTB).

The results show that the teachers reacted well to the session and had high levels of enthusiasm for learning types and instructions based on learning styles. The participants found the training quite informative and offered insights on implementing such training at the school level. Participants remarked that they appreciated all the activities. One participant commented:

> Our group presentation was informative and insightful as it focused on raising awareness about the variations among learners in our classrooms. I am now aware that some of my learners are visual/verbal, some are intuitive/sensory and others are active/reflective. All along, I thought there are individual differences in my classroom but not to the extent I know now. This workshop was a training session focused on raising awareness. I have gained a better understanding of how to accommodate diverse learners in my science classroom (PSTC).

The participants engaged in productive learning by collaborating in groups, offering recommendations, sharing expertise, and learning passionately from each other and the facilitator. One participant described the experience:

> It was indeed highly engaging and enlightening, prompting critical thinking and articulating feelings of being left behind with these instructional strategies. The knowledge I have gained in the use of demonstrations, resources improvisation and discussion to cater to the differences learners bring to the science classroom when teaching electricity and magnetism and to an extent, all other concepts in physical sciences (PSTD).

Participants generally agreed that despite the challenges in science education in South Africa, a shift towards aligning teaching methods to learners learning preferences in science teaching should be promoted. This approach aims to provide science teachers with the necessary skills to enhance the accessibility and enjoyment of science content for learners.

Three teachers responded in agreement with the opinion that teachers use LSBIS to cater to how learners learn. Here is their response to the question:

> Learning style-based instructional techniques are teaching methods that teachers utilise depending on how their learners learn (PSTA).
>
> Instructional techniques based on learning styles involve teachers adapting their teaching methods to align with how learners absorb and process information. It also includes teachers adjusting their teaching approaches to align with how students learn (PSTB).
>
> A learning style-based instructional strategy is an education method where teachers customise their instructions to match learners' preferences in learning (PSTD).

The teachers' comments demonstrated a thorough understanding of learning style-based instructions.

When the participants were asked about their perspectives on the benefits of using LSBIS in the science classroom, many respondents emphasised the need to develop engaging classes to facilitate science learning. One teacher narrated:

> Indeed, this teaching method has led to the active participation of my learners in the physical science classroom. My learners struggle each year to understand electricity and magnetic concepts over the years. However, since I began considering the way they learn in my style of teaching, there has been much improvement in their conceptual understanding of this concept. I am indeed a happy teacher this year (PSTA).

Some teachers argue that using teaching strategies tailored to learners' learning styles enhances academic performance on the topic. They narrated:

> Utilising LSBIS has worked for me in concepts such as work, energy and power and electrochemical reactions which are concepts learners find difficult to conceptualise This has created a positive learning environment for all learners (PSTC).

> When I started using an LSBIS technique in teaching the photoelectric effect concept, I noted that my learners have been motivated to learn more and they have become actively engaged in the lessons. No one in the class sleeps, and no one finds the material difficult (PSTB).

There was a prevalent pattern in the participants' feedback on including students with various learning styles in science classrooms. Teachers' responses suggested that increasing the use of various teaching styles should be introduced gradually in the classroom rather than enforced. Helping students recognise their learning styles and embracing their uniqueness will enhance their experiences in science. One teacher explained:

> I started using LSBIS in my classroom immediately after the workshop on teaching mechanisms of reaction and catalysis. I used simulations to show the collision of the particles in substances, and I used illustrations, accompanied by discussions, and inquiry-based activities to get all learners actively engaged to facilitate the implementation of differentiated teaching. The learners benefited from structured lessons that accommodated all learners without excluding anyone (PSTC).

Teachers demonstrate a strong understanding of the various learning styles in their classroom based on their responses. The participants indicated that they determined their students' preferred learning modes by observing, assessing, and communicating with them. They used this insight to customise their teaching strategies, resources, and tasks to effectively address the unique learning needs of each student. Participants responded:

> As a teacher, I identify the learning needs of my learners through continuous observation. I closely monitor their engagement levels, task completion progress, and participation in classroom discussions. I routinely analyse their performance in each task to pinpoint areas where they might want further assistance. For this reason, I have customised my teaching approaches especially in challenging topics in science using demonstrations, illustrations, real-world scenarios, and problem-solving to accommodate the varied needs of my learners (PSTD).

Understanding the educational needs of learners entails establishing robust relationships with them. One teacher narrated:

> I value transparent communication and frequently participate in individual conversations to understand their preferences, skills, and challenges. I provide a welcoming and accepting classroom atmosphere to empower students to communicate their issues and articulate their educational choices. Through this, I am able to adjust my teaching methods and materials to cater to the individual needs of each student. I recognise that my students come from diverse backgrounds and may require certain educational tools to excel in my science. I understand the learning style variances that learners exhibit in my science classrooms. To meet my students' learning needs, I use a range of assessment tools (PSTA).

Through discussions with the participants, it was clear that they see understanding students' learning styles as essential to their teaching approach. This implies that teachers can enhance learner learning by consistently evaluating and recognising the distinct skills and preferences of each learner to customise their instruction accordingly.

5.3. Teachers' Perceptions of the Challenges of Implementing Learning Style-based Instructional Strategies

When questioned about teachers' perspectives on the difficulties of incorporating LSBIS in their science classrooms, many voiced out about insufficient preparation time, lack of resources, and financing. Teachers described the difficulties they experienced when incorporating LSBIS, expressing concerns about the time and effort required for planning and implementation. They narrated:

> I am concerned about the time and effort I invested in designing and executing learning style-oriented instructions. The one-hour time slot provided to me at this school is insufficient to finish a lesson (PSTD).
>
> Utilising instructional strategies based on learning styles necessitates increased planning and preparation for each lesson (PSTA).
>
> As much as I like using LSBIS, however, it demands increased teacher time. Therefore, I consider it a hardship because I am already overwhelmed (PSTB).

Utilising instructional strategies based on learning styles necessitates more planning and preparation for each topic. One teacher expressed concern about students' behavioural issues and attitudes towards using LSBIS. He stated:

> We do not have resources. The resources provided by the researcher will soon be depleted. How do we continue with this method if resources are not adequate? (PSTC).

Access to materials is crucial for implementing LSBIS which meets the needs of all learners with varying learning styles. Teachers indicated that having access to resources, as well as receiving in-service training, would motivate them to utilise LSBIS. Teachers need continuous training to prepare and collaborate with colleagues to expedite change effectively. Similarly, some teachers were greatly concerned about the lack of adequate preparation to implement LSBIS. These teachers see integrating several instructional methodologies as merely increasing their workload on already busy schedules. One participant commented:

> Using LSBIS is very challenging for me. This is because I need a significant amount of energy and time to plan and present this instructional technique. I need to plan to cater for the visual/verbal, active/reflective and all other learners' learning styles. Yet, the effect is that I often get tired during the preparation and execution. As a result, I always opt to shift back to traditional teaching methods in my next lesson. What I am trying to say is that I do not implement LSBIS in all my classes (PSTD).

Other teachers expressed dissatisfaction with their sizable classrooms, which often included 55-60 students. They expressed the challenge of managing 50 or more students in a classroom and tailoring teachings to each learning need. However, they were of the view that although, they try to do their best to continue with LSBIS. One teacher lamented.

> My school does not have enough resources to continue with LSBIS. However, I have observed that some students become disinterested when the instruction does not accommodate their learning patterns (PSTC).
>
> I decided to discontinue this method of teaching due to the challenges I initially highlighted. However, I have observed that the influence on learner performance will be devastating (PSTB).

The participants complained about not being able to complete the syllabus within the designated timeframe and that affected learner performance in those topics that were accessed in the district common assessment in June. The teachers believed that the LSBIS approach is time-constrained and requires careful planning and preparation before being used in the classroom.

5.4. Support Received from the School when Implementing the Learning Style-based Instructional Strategies

Teachers emphasised the need for important materials to support the delivery of LSBIS. Teachers require a diverse range of resources, including instructional materials, technological tools, and hands-on resources to accommodate different learning styles. One teacher lamented:

> Although my school does not have much of digital tools, my principal sometimes borrows from other schools. I have used simulations in chemistry teaching and I have seen that these digital tools in combination with other aspects of problem-solving and discussion approaches greatly assist in teaching electrochemical reactions to cater to different learning styles, despite the time and effort required to put them up (PSTC).

The participants were of the view that it was essential to allocate time for them to interact and plan together as teachers. This will enable them to exchange insights, generate ideas, and create teaching strategies customised for various learning styles as a group. One participant suggested:

> The schools may offer flexibility in the curriculum to cater to different learning styles. This might include offering various choices for tasks, initiatives, and evaluations that enable us- the teachers to demonstrate our abilities and inclinations. In addition, the school management team could provide resources such as laboratory equipment, and chemical reagents to facilitate the conduct of practical work to cater to different learning styles (PSTA).

Responses from the participants also highlighted the engagement of parents and the wider community by providing instructional sessions for parents to help them comprehend and assist various learning styles at home. Participants believed that schools should encourage a culture of ongoing learning for teachers to promote teachers' involvement in conferences, online courses, and professional learning communities that emphasise diverse teaching and learning styles. This will enable teachers to remain current in the most recent research and effective strategies in the subject.

6. Discussions

This section presents a discussion that emerged from the results on the perspectives of physical science teachers on the implementation of instructional strategies based on learning styles in science classrooms. It focuses on the challenges and opportunities associated with this approach. The discussion is structured around the four main themes that were identified from the data. The discussion focuses on analysing these themes within the context of Felder-Silverman's learning style model and social constructivist theory based on relevant literature. Integrating learning style theories with constructivism in teaching approaches can provide a dynamic and inclusive learning environment to build learners' knowledge, promoting more profound learning and critical thinking abilities.

It emerged from the findings of the study that teachers viewed LSBI as beneficial since it made science lessons engaging and facilitated science learning for all learners. The finding revealed insights into teachers' perspectives of LSBIS as beneficial because it improves learners' collaborative participation in science lessons. This implies that adapting teaching approaches to align with the specific learning styles, such as visual, verbal, or active, of each learner, to better suit their preferences and abilities can result in improved engagement and understanding among learners who may otherwise have difficulties with traditional teaching methodologies. This finding also suggests that involving learners in activities that correspond to their preferred learning styles might promote a more profound grasp of physical science concepts. For instance, the inclusion of visual aids or hands-on activities might enhance the understanding of abstract topics for those who learn best through visual or intuitive. This finding supports the claim that students' motivation, performance, and achievement improve when their learning styles align with teaching styles, as opined by Alnujaidi (2018). This finding further confirms earlier findings by Rinekso (2021) that aligning learning styles with teaching styles resulted in favourable outcomes for the learning process, such as increased motivation, engagement, and accomplishment. The finding further aligns with the constructivism theory which indicates an active participation of learners in a lesson to develop their understanding of topics (Bai et al., 2018), and confirms the theoretical proposition that emphasises the need to create a motivating learning environment for learners to actively participate in the learning process (Baldock & Murphrey, 2020). The LSBIS is important for creating instructions that match learners' learning styles by focusing on customising educational experiences to meet individual student's needs and backgrounds (Kiss & Redlo, 2020).

This implies that helping learners recognise their learning styles and embracing their uniqueness can enhance their experiences and diversity in physical science.

It also emerged from the findings of the study that teachers demonstrate a strong understanding of the various learning styles and learner needs in science classrooms. The teachers were of the view that seeing, assessing, and interacting with learners, may determine if their learners prefer visual, verbal, intuitive, global, sequential, or other learning modes. This finding implies that understanding the educational needs of learners entails establishing robust relationships with them. This finding aligns with the expectations set forth by the Felder-Silverman learning style model (Felder & Brent, 2005; Litzinger et al., 2007) and confirms the theoretical proposition that learners have diverse learning preferences. Felder and Silverman (1988) utilised several teaching methods to align with the preferences of the learners' learning styles. Nonetheless, Felder and Silverman, opined that learners who prefer a specific learning style may encounter challenges if teaching styles differ from their preferences. Therefore, Dunn (1990) emphasises the significance of teaching learners by employing techniques that cater to their conceptual preferences among various teaching strategies. In contrast to Dunn's (1990) assertion, Cabrero (2006) argues that utilising various teaching styles will affect the quality of education from a collaborative perspective. However, other studies have affirmed the adoption of teaching styles to match learning styles as essential to accommodate the variety of learners in the classroom and enhance information retention, as affirmed by Shaidullina et al. (2023), and evident in this study.

Constructivism philosophy highlights the active creation of knowledge by learners through their experiences and interactions with the environment (Vygotsky, 1978). This theory suggests that learners are central to the learning process and actively participate in developing their understanding of topics (Bai et al., 2018). The constructivism approach emphasises the need to create a motivating learning environment for learners to actively participate in the learning process (Baldock & Murphrey, 2020). LSBIS supports instructional materials that are relevant and engaging to catch learners' interest and encourage their involvement with the subject matter (Bella et al., 2021). This supports the concept that learners build knowledge through their own experiences and interactions with educational resources (Sajadi & Khan, 2014). However, the findings of the study indicate that teachers experience challenges when using learning style-based instructions in their classrooms. These challenges were the complexities of tailoring instructional approaches to suit individual learning preferences, teachers' reluctance to embrace change or limitations imposed on resources, insufficient planning time, tools, resources, large class sizes, and workload. This finding reflects the tension between constructivist ideals of student-centered learning and traditional teacher-directed instruction. Furthermore, the results indicate that it was difficult to recognise various learning styles and tailor instructions accordingly. The results support previous research that has identified learners' learning styles (Sahid et al., 2017) and highlighted the difficulty of customising instructional methods and activities to match learners' learning styles (Magulod, 2019). Another difficulty encountered by teachers while using the LSBIS approach was their incapacity to complete the syllabus within the stipulated timeframe. The teachers believed that the LSBIS approach is time-sensitive and requires thorough planning and preparation before being applied in the classroom.

It also emanated from the findings of the study that teachers see the benefit of implementing LSBIS to enhance student performance in the physical sciences. However, the teachers were of the view that adapting instructions to suit the learning styles of individual learners is challenging. Nonetheless, if LSBIS is not continued with its implementation, it will affect learners' learning and achievement in physical sciences. The findings show that teachers emphasised the need for critical teaching resources to support the delivery of LSBIS that meet the needs of different learners in the physical science classroom. Dunn and Dunn (1978) recommended utilising hands-on materials, movies, visual aids, and computer simulations. This implies that teachers should have the opportunity to utilise and enhance these activities in their physical science classrooms. By utilising necessary materials efficiently can help teachers enhance student performance in science. This

finding aligns with the results of Herman et al. (2013) study which indicated that the degree of internalising new information and behaviours rises in proportion to the level of consistent dedication. This implies that teachers can enhance learners' learning by consistently recognising the distinct skills and preferences of each of their learners to customise their teaching approach as they seek support in the form of the provision of adequate resources to necessitate the implementation of LSBIS.

7. Conclusion

The South African government has focused on improving teaching and learning at the high school level across the country. This study has provided insight into the complexities of incorporating instruction based on learning styles in science classrooms. By examining the viewpoints of teachers, this study has identified many significant themes that highlight the opportunities and challenges associated with this teaching method. The findings emphasise the intricacy of adjusting teaching methods to suit various learning preferences while managing the limitations of time, money, and institutional requirements. Teachers expressed concern about the practicality of tailoring instruction to each student and the possibility of oversimplifying the complex structure of student cognition using learning style profiles. The teachers believed that external constraints including limited resources, planning time, staff development, and attitudes had the most significant impact on implementing teaching methods that cater to different learners in the science classroom. Although there are challenges in implementing LSBIS, this study reveals the abundant possibilities of using LSBIS to improve student engagement, understanding, and motivation in science teaching and learning. Teachers showed eagerness to integrate LSBIS, such as visual presentations, hands-on experiments, and collaborative group activities, that are in line with constructivist concepts of active learning and knowledge creation. This study contributes to the discussion on theory and application by using qualitative research to explore teachers' perspectives on this intervention. It is envisaged that teachers would transition from traditional instructional strategies that make learners passive in the teaching-learning environment.

8. Recommendations

The study findings suggest the following recommendations for implementing in high school science teaching and learning:

- High school science teachers should be encouraged to analyse their teaching methods as they incorporate instruction tailored to different learning styles.
- Future studies might explore the same research questions with expanded sample size, involving both teachers and students or expanding outside the domain of science education to other educational disciplines. A potential alternative method may involve a comparative analysis of student attitudes and academic performance before and after implementing the remedial programme suggested in this research.
- It is recommended that the knowledge obtained from teachers' viewpoints, researchers, and policymakers may cooperate to create evidence-based strategies that enhance student learning outcomes and foster an inclusive, student-focused science education.

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Data availability: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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